IOWA HIGHWAY RESEARCH BOARD (IHRB)

Minutes of February 28, 2014

Regular Board Members Present

A. Abu-Hawash
K. Jones
M. Kennerly
R. Younie
S. Okerlund
R. Knoche
D. Schnoebelen
R. Kieffer
W. Weiss
P. Assman
K. Mayberry
L. Roehl
R. Fangmann
T. Wipf

Alternate Board Members Present

L. Bjerke for D. Miller
P. Mouw
J. Thorius

Members with No Representation

None

Secretary - M. Dunn

Visitors

Gordon Smith	Iowa Concrete Paving Association
Scott Neubauer	Iowa Department of Transportation
Wayne Sunday	Iowa Department of Transportation
Linda Narigon	Iowa Department of Transportation
Mike Nop	Iowa Department of Transportation
David Lee	University of Iowa
Marian Muste	University of Iowa
Sri Sritharan	Iowa State University/InTrans
Chris Williams	Iowa State University/InTrans
Peter Taylor	Iowa State University/InTrans
Doug Gransberg	Iowa State University/InTrans

The meeting was held at the Iowa Department of Transportation Ames Complex, Materials East/West Conference Room, on Friday, February 28, 2014. The meeting was called to order at 9:00 a.m. by Chairperson Kevin Mayberry with an initial number of 15 voting members/alternates at the table.

Minutes

Motion to approve Minutes from the December 12, 2013 meeting

Motion to Approve by R. Knoche; 2nd B. Younie
Motion carried with 15 Aye, 0 Nay, 0 Abstaining.

Second Round RFP Proposal Review and Selection FY 13-14:

PROPOSAL, *"Design and Performance Verification of a Bridge Column/Footing/Pile System for Accelerated Bridge Construction (ABC)",* Sri Sritharan, ISU/InTrans, ($184,956)

BACKGROUND

Given the recent success in the development of accelerated construction details for bridge columns and decks, the scope of the proposed research is to arrive at appropriate design details for pile-to-pile cap connections and validate their behavior through needed component testing. By means of this process, the intent is to establish suitable details for full ABC solutions (i.e., from foundations to superstructure) for routine bridges.

OBJECTIVES

The objectives of this project are as follows:

- ✓ Identify the various ABC foundation connection details in existing literature, including their merits and deficiencies;
- ✓ Develop column-to-pile cap/foundation connection details, that can be implemented economically and effectively using ABC methodology;
- ✓ Validate performance of proposed connection details through laboratory tests;
- ✓ Validate the system performance analytically through consideration of soil and foundation interaction; and
- ✓ Recommend design guidelines and details based on test results, and present design recommendations and examples in a technical report.

Motion to Approve by A. Abu-Hawash; 2nd T Wipf
Motion carried with 15 Aye, 0 Nay, Abstaining.

PROPOSAL, *"Evaluation of Otta Seal Surfacing For Low-Volume Roads in Iowa",* Halil Ceylan, ISU/InTrans, ($149,995)

BACKGROUND

There are several advantages of using Otta seal:

1. It allows the use of uncrushed aggregate leading to cost reduction in aggregate production and transportation;
2. It acts as an impermeable surfacing by filling up aggrade voids thus preventing water from penetrating moisture-susceptible gravel roads;
3. It does not require the use of a prime coat in construction;
4. It can be opened to traffic immediately after construction;
5. It needs fewer periodic maintenance activities between reseals;
6. It uses recycled unbound or stabilized material after pulverization. However, it cannot add any structural capacity to the roadway (although it can maintain the existing

structural capacity by preventing moisture ingress), and therefore enough substructure support is required to support the anticipated traffic loading (Johnson 2011, Weiss 2010).

Otta seal can be placed in one or two layers with or without a sand cover seal depending on the aggregate properties, traffic volume, construction cost and required service life (Overby 1999). The use of a sand cover seal is recommenced to reduce the rate of oxidation of the surfacing asphalt binder under hot temperature conditions (Overby 2006). When applying two layers to accommodate higher traffic in the same season, it is recommended to place the second layer two to three months after the first (Weiss 2010). Figure 2 presents a schematic illustration of single and double Otta seals along with other types of BST.

OBJECTIVES

The objectives of this project are to:

- ✓ Evaluate the feasibility of Otta seals as an alternative surface treatment on low volume roads using local aggregate, including lower quality aggregates.
- ✓ Evaluate the cost-effectiveness and performance of Otta seals compared to traditional bituminous seal coat surfaces, and compared to maintenance of granular surfaced roads.
- ✓ Develop a guide for road selection in regard to the use of Otta seals as an alternative, and develop guidelines for construction of Otta seals.
- ✓ Identify local projects that can be sites for field demonstrations to represent a range of locally available aggregate in different areas of the state. This study would fund the cost of testing and evaluation of participating projects. The evaluation should include roadway characteristics, aggregate properties and characteristics, performance under various conditions including maintenance practices and costs prior to installation of Otta seal to compare benefits to cost.
- ✓ Evaluate installed Otta seals performance through seasonal changes (i.e. winter, spring/thaw, summer, etc) environment, and traffic loading conditions through laboratory testing and field demonstration.

DISCUSSION

- Two good proposals. Both met RFP, but have different approaches.
- The proposal submitted by Dr. Ceylan fit the intent of we were looking for more. His proposal was more field oriented.
- Lab performance testing, while not always directly relating to field performance, can be valuable for binder selection. We do not use as many chip seals on the Primary system since the binder selection with the materials being used on a project can be difficult without performance testing. That aspect was a positive to the proposal submitted by Dr. Lee, University of Iowa. There may be a potential to do that part at a later time.

Motion to Select/Approve the proposal submitted by Dr. Ceylan, Iowa State University by P. Assman; 2nd B. Younie
Motion carried with 13 Aye, 0 Nay, 2 Abstaining (Wipf, Schnoebelen).

The proposal submitted by Dr. Lee, University of Iowa was not selected.

PROPOSAL, *"Assessment of PCC Concrete Setting Time and Joint Sawing"*, Peter Taylor", ISU/InTrans, ($74,938)

BACKGROUND

It is reasonable to assume that the start of the sawing window can be correlated with the initial set because both are affected by the same factors. A pilot project conducted by the team (Taylor 2014) indicated that this is so and that sawing can start at about 220 minutes after initial set for the sites that were visited. The limitation of the project was that all of the field work was conducted with early entry saws, and all with similar mixtures, 7 of 8 of which contained limestone aggregate.

It has been reported that an Australian contractor (Whitaker 2012) is finding financial benefit in using a calorimeter because few slabs have to be replaced due to random cracking, and overtime costs are reduced because sawing crews are called to the site when needed without having to wait around for the concrete to stiffen.

OBJECTIVES

The objective of the work described in this proposal is to:

- ✓ Evaluate the suitability of using p-wave, i-button/maturity meter or calorimetry approaches to measure initial set in the field
- ✓ Assess the validity of using initial set to determine the sawing window for a range of mixtures, aggregates and sawing techniques, and to
- ✓ Develop a protocol to assist implementation of the approach

Motion to Approve by R. Fangmann; 2nd K. Jones
Motion carried with 15 Aye, 0 Nay, 0 Abstaining.

PROPOSAL, *"Impacts of Internally Cured Concrete Paving on Contraction Joint Spacing"*, Peter Taylor", ISU/InTrans, ($120,000)

BACKGROUND

Lightweight fine aggregate is finding increasing application in the construction of bridge decks because of the improvement in strength development and potential durability while reducing cracking risk. This improvement is achieved by the small lightweight particles uniformly providing water to the mixture as hydration proceeds. This internal curing (IC) reduces the risk of internal desiccation in low w/cm mixtures, and helps to level out variation in moisture content through the thickness of the slab. Their use in pavements is less common, one trial section built in Texas and one about to be built in Kansas.

In some mixtures, particularly those with very low w/cm (below 0.40) there is a real risk of internal desiccation because insufficient water is available to hydrate all of the cement in the mixture. This can lead to autogenous shrinkage, and in the extreme, a loss of performance over time.

Most curing activities are applied to the surface of the concrete, and their effect is largely limited to a small zone near the surface. Therefore, surface curing, while essential for surface durability, will not likely provide a significant benefit more than about an inch below the surface. Internal curing, however, will be effective through the depth of the pavement and so reduce differential moisture contents that cause warping.

Internal curing is the practice of providing reservoirs of water within the mixture that are not part of the initial mixing water. The water is, however, released later to maintain sufficiently high RH in the pore system for hydration to proceed. Practice in the USA is to use lightweight fine aggregate (Figure 1) that is saturated before mixing. Fine aggregate is preferred to coarse aggregate because the particles are finely distributed through the mixture, thus maximizing the benefit through the whole volume.

OBJECTIVES

The objective of the proposed work is to perform laboratory and field testing and evaluate a concrete pavement constructed with and without IC concrete in an overlay section. The CP Tech Center will conduct material tests on the concrete mixtures used in the pavement during construction. Sensors will be embedded in the pavement to monitor temperature and moisture profiles. These sensors will be examined periodically over one year to observe seasonal affects. In addition, surveys will be conducted quarterly to observe and record the amount of warping cracking as a function of daily and seasonal environmental changes.

A County road that is being overlaid in 2014 will be used for analysis. Details of the overlay design will be at the behest of the County, who will also be responsible for the cost of construction. Work discussed in this proposal will be to provide assistance as needed to prepare mixture proportions, test the mixtures in the lab and the field, and to monitor the pavement for one year. It is likely that the lightweight material can be obtained at no additional cost to the owner.

Motion to approve with maximum expenditure of $35,000 for phase I work. An interim report will be presented to the Board prior to proceeding with additional tasks. - K. Jones; 2nd L. Bjerke
Motion carried with 15 Aye, 0 Nay, 0 Abstaining.

PROPOSAL, *"Performance based Evaluation of cost Effective Aggregate Options for Granular roadways"*, Doug Gransberg", ISU/InTrans, ($150,000)

BACKGROUND

The Federal Highway Administration (FHWA) estimates that $170 billion per year is needed to bring the nation's infrastructure to a good condition (ASCE 2013a). Among the infrastructure systems that need capital investments, roads have been graded with a failure grade D (ASCE 2013a). Poor road conditions cost motorists $101 billion a year in repairs and operating costs (ASCE 2013a). Starting with North Dakota in 2005, many county-level road agencies have been determining that the cost of repairing or replacing failed pavements has become so high that they are making a conscious decision to return low volume paved roads to granular roadways. A report by the National Associate of Counties (Taylor 2010) found that "counties in Iowa, Michigan, California and South Dakota are among those that have decided either to stop maintaining a

percentage of their asphalt roads or to pulverize some paved roads and downgrade them to gravel." Recently the Texas Department of Transportation (DOT) has been exposed to a large amount of negative press for making the same decision on approximately 100 miles of its Farm to Market road system (Taylor 2013). In all cases, the engineers determined that it was in the best interests of the taxpayer to regress from an expensive to maintain pavement to a granular material surface on roads where the traffic is very light; usually less than 200 vehicles per day (vpd). A report done for the Minnesota DOT indicated that 200 vpd was the level of traffic where it became economic to upgrade a granular road to pavement (Jahren et al 2005).

Pavement condition data for Iowa is also alarming. An estimated 46% of major roads in the state are in poor or mediocre condition, and vehicle travel on Iowa's highways increased 57% from 2 1990 to 2004 while lane miles were not increased at all (ASCE 2013b). Iowa motorists spend "$756 million a year in extra vehicle repairs and operating costs - $381 per motorist" (ASCE 2013b). Hence, the problem in Iowa will become more than just how to maintain its existing unpaved road network and include the need for design and cost criteria for assisting agency engineers in making the decision to return a low volume surface from pavement to granular material.

OBJECTIVES

The project has six objectives to accomplish the final goal of developing a granular l road guidebook and toolkit for selecting an appropriate granular road design through evaluating benefits of locally available options from "do nothing" to full replacement.

1. Develop a framework for evaluation and selection of locally available options for granular material when the conditions of a road section is given.
2. Construct and monitor field test sections in typical locations dispersed around the state, on existing road known to have high quality subgrades. The test section output will be used to develop deterioration curves with respect to measurable roadway variables, roadway properties, and aggregate properties that can be determined either in the field or the lab.
3. Develop a methodology in assessing life cycle costs based on the objective 2 deterioration curves of various options available for Iowa granular roads.
4. Develop a spreadsheet-based decision tool for selecting the most appropriate granular material option.
5. Conduct case studies using the tool developed in this project and validate the tool.
6. Train agency engineers for rapid dissemination of the tool

DISCUSSION

- The proposal was more based on asset management tools than on field evaluation and characterization of aggregates in the lab, as was intended in the RFP.
- There was some difficulty in scoping the RFP, and it appears there was some confusion on what the Board was trying to accomplish.
- This proposal should be discussed at the Local Transportation Asset Management Committee to get feedback regarding some common issues.
- The lab tests that are currently used for aggregate performance are not the best and this project might benefit from looking at other potential tests that may improve testing.

Motion to table for further discussion and re-scoping of the project. - W. Weiss; 2nd R. Fangmann
Motion carried with 15 Aye, 0 Nay, 0 Abstaining.

FINAL REPORT TR-646, *"Development of Bridge Inspection, Load Rating & maintenance Manuals"*, Scott Neubauer, Iowa DOT ($289,494)

BACKGROUND

The purpose of this manual is to organize, document, and combine Iowa Department of Transportation (Iowa DOT) policies and procedures for bridge inspection practices and post-inspection recommendations so Iowa DOT personnel, local agencies, and consultants will have a readily available resource for their use. Previously, bridge inspection policies and procedures were documented by various means, making it difficult to provide consistent answers to questions regarding bridge inspection topics. This manual is intended to ensure uniformity and document best practices for inspection of Iowa's bridges, especially as experienced inspection personnel retire.

DISCUSSION

Q. Have you discussed having a workshop as far as technology transfer for the Counties?
A. Yes, we could definitely do this, such as a webinar. We could discuss to the people what is in the manual and how to use the manual.

Q. Have you publicized this manual to the Public, Counties or Cities?
A. A note has been sent through the Office of Local Systems letting them know it was available.

Q. Is this manual applicable to other States?
A. We wrote this to Iowa specifically, but any State could pick these up and use them. There is no restriction on who could access these manuals.

Motion to Approve by R. Knoche; 2nd D. Schnoebelen
Motion carried with 15 Aye, 0 Nay, 0 Abstaining.

FINAL REPORT TR-*639, "Development of Bio-Based Polymers for Use in Asphalt"*, Chris Williams, InTrans ($149,958)

BACKGROUND

Asphalt binder used for high-performing pavements needs sufficient properties to resist cracking at low temperatures and rutting caused by shear forces from sustained loads at high temperatures. To produce an asphalt binder with these performance characteristics, the binder is commonly modified with elastomeric polymers to improve its rheological properties and lower its temperature susceptibility over a range of in-service pavement temperatures.
The most common elastomeric polymers used for asphalt modification are styrenic block copolymers (SBCs). SBCs are composed of blocks of polybutadiene and polystyrene to produce styrene-butadiene (SB) diblock polymers and styrene-butadiene-styrene (SBS) triblock polymers.

Recent advances in polymerization techniques have led to the development of elastomeric block copolymers produced with polystyrene and polymerized soy-derived triglycerides. While the past two decades of plant-oil based polymer research has yielded only thermosets, the newly produced polymers are thermoplastic elastomers that are processable at high temperatures.

OBJECTIVES

This project supports the development of an innovative route to thermoplastic-elastomeric SBCs based largely on soybean oil, a renewable and biodegradable feedstock. The new class of SBCs contains a biopolymer derived from triglycerides in soybean oil that replaces the "B" block polymer (polybutadiene) in the block copolymer structure of SB and SBS. The efficacy these soy-based block copolymers as an alternative to the traditional polymer modifiers used in the asphalt industry are evaluated for this project. The objectives of this project are as follows:

- ✓ Identify the most promising polymerization chemistries for forming linear-chain polymers from vegetable oils.
- ✓ Synthesize soy-based biopolymers with blocks of polystyrene (PS) and polymerized soybean oil (PAESO) to create block copolymers with diblock (PS-PAESO) and triblock (PS-PAESO-PS) structures that use PAESO as a replacement for polybutadiene. Characterize the thermal, rheological, and morphological properties of these materials.
- ✓ Formulate blends of the diblock and triblock biopolymers with asphalt binder and quantitatively evaluate their influence on asphalt binder performance; compare these results with commercially available SB and SBS polymers.
- ✓ Evaluate the economics of the biopolymers as asphalt modifiers.

DISCUSSION

Q. In relation to the implementation basically are you at the point of waiting for this facility to construct, and to get enough quantity to do full scale testing?
A. Yes, this pilot plant will be able to produce 5 tons of mix each week using the polybutadiene.

Q. Is there any other market for this besides asphalt?
A. Yes, we would supply into this market a feed stock for polybutadene replacement. It can be used in the sole of your shoe, tires, covers for electronics, it goes in 1,000's of other products.

Motion to Approve by B. Younie; 2nd P. Assman
Motion carried with 15 Aye, 0 Nay, 0 Abstaining.

FINAL REPORT TR-619*, "Development of Self-Cleaning Box Culvert Design – Phase II*, Marian Muste, The University of Iowa, ($)

BACKGROUND

The present study is an integral part of a multi-phase study focused on the design and implementation of self-cleaning culverts, i.e., configurations that prevent the Formation of sediment deposits after culvert construction or cleaning. Box culverts are generally designed to handle events with a 50-year return period, and therefore convey considerably lower flows much of the time. While there are no issues with conveying high flows, many multi-box culverts in Iowa pose a significant problem related to sedimentation due to the highly erosive Iowa soils. Phase I of

this IHRB project (TR-545) led to an innovative solution for preventing sedimentation. The solution was comprehensively investigated through laboratory experiments and numerical modeling aimed at screening design alternatives and testing their hydraulic and sediment conveyance performance. Following this study phase, IHRB suggested implementation of the optimal mitigation design found in Phase I to a field site.

OBJECTIVES

The main objectives of this research are:

1. Identification of a multi-box culvert prone to sedimentation continuous for long-term monitoring.
2. Monitoring of the selected culvert prior and after to sediment cleanup for assessing the efficacy of the self-cleaning designs and the role of other factors involved in triggering sedimentation.
3. Establishing self-cleaning culvert design specifications.
4. Monitor the self-cleaning culvert after construction. For this purpose a real-time web-camera and a stage sensor were deployed at the culvert site.

Motion to Approve by W. Weiss; 2nd R. Knoche
Motion carried with 15 Aye, 0 Nay, 0 Abstaining.

NEW BUSINESS

A plaque was presented to Kevin Jones, representing the Iowa DOT Office of Construction and Materials, for the selection of their project *Evaluation of the RapidAir 457 Air Void Analyzer* as a finalist in the AASTO RAC High Value Research.

Reminder: 2014-15 Project voting and ranking will be done at the March meeting.

ADJOURN

The next meeting of the Iowa Highway Research Board will be held Friday, March 28, 2014, in the East/West Materials Conference Room at the Iowa DOT. The meeting will begin promptly at 9 a.m.

Mark J. Dunn

_____

Mark J. Dunn, IHRB Secretary